

Sloan Digital Sky Survey-II

Schedule for the Three-Year Baseline Plan for SDSS-II Operations

Introduction

SDSS-II proposes to create three surveys of the sky: complete the spectroscopic footprint of SDSS-I ("Legacy"); Galactic structure in both photometry and in spectroscopy ("SEGUE"); and an imaging survey for Type Ia supernovae ("SN"). This document shows how these surveys fit together, how time is apportioned, and provides benchmarks against which progress can be reckoned. In more detail:

Legacy intends to complete the coverage of the sky in the area defined by stripes 10 through 37, inclusive, in both imaging and spectroscopy. (The system of stripes is defined at <http://www.sdss.org/dr4/coverage/atStripeDef.par>.) The spectroscopic targets (galaxies and quasars) will be selected in the same way as for SDSS-I. The data quality criteria will be the same as for SDSS-I.

SEGUE intends to scan approximately 3500 square degrees of sky outside of the North Galactic Cap in a pattern such that no part of the sky with declination greater than -20 degrees is more than 20 degrees away from a stripe. The pattern includes scans that pass through the Galactic plane, but there is no requirement for the quality of data in fields where the SDSS photometric pipeline fails because of varying background or excessive image crowding. Approximately 200 spectroscopic tiles will be observed spectroscopically. Within each tile, approximately 1200 stars will be selected with a uniform algorithm to achieve specific goals, e.g. measuring the velocity and metallicity distributions in the Galactic halo, sampling the thick disk - spheroid interface at higher Galactic latitudes, and measuring the initial mass function and age distribution for stars in diverse regions. One hundred and thirty-five of the tiles will uniformly probe the Milky Way at all accessible longitudes and latitudes, and 65 will sample specific directions, such as well-calibrated open clusters. The plan for the SEGUE stripes and tiles is available at: <http://home.fnal.gov/~yanny/fut/layout.html>.

SN intends to scan repeatedly the celestial equator from $RA = 20h$ to $RA = 4h$ in September, October, and November in each of the three years, with a time-sampling that is as dense as possible, where an increasing fraction of the time is yielded to the other surveys in November. These observations will yield light curves for numerous variables, including about 60 Type Ia supernovae per season. These events will be announced as quickly as possible to enable spectroscopic follow-up with other telescopes.

Overview of the Integrated Baseline Plan

In the three years of SDSS-II operations, the goal is to complete the science outlined above for all three surveys. Two of the surveys are in opposite regions of the sky (Legacy and SN), and the third (SEGUE) requires imaging and spectroscopy at all seasons.

The SDSS-I experience allows us to compute average weather conditions and average observing efficiency. For time that is astronomically useful, it also allows us to compute the average of that time that can be used for imaging (photometric skies and good seeing). These average values are adopted to scale the available time into expected values for survey progress in units that can be compared against the survey goals, e.g. square degrees of sky and number of spectra.

For SEGUE, each of the 200 tiles on the sky is observed with two plates, one with a relatively short exposure for the brighter stars, and one with a relatively longer exposure for the fainter stars. We have determined that the net observing time (including overhead for swapping plates, etc.) required for one SEGUE plate pair is about 4.8 hours. (Note that the tables below refer to tiles, as opposed to plates.)

For imaging, we adopt the metric of "unique" square degrees. These are square degrees that have been corrected for overlaps of the scan lines in each of the two strips of a stripe, as well as for the end-to-end overlap where different runs of the same strip have been spliced together. "Unique" square degrees does not account for the "barrel-stave" overlap of the system of stripes for Legacy - that is accounted for in the "footprint" category. For SEGUE, the stripes are distinct and "unique" and "footprint" are equivalent.

A model observing plan has been devised that apportions time to the three surveys as a function of month of year, for each of the three years. The available time is dark time corrected for weather, minus one dark run in July/August for mirror re-aluminization and other maintenance. The demands by each of the three surveys in each month are defined by the following protocols:

- 1) If an unobserved Legacy stripe or spectroscopic plate is available in a part of the North Galactic Cap between stripes 10 and 37 that is currently accessible, observe that stripe or plate.
- 2) September, October, and most of November are allocated to the Supernova survey, where imaging is attempted even in spectroscopic conditions. The right ascension range of the Supernova survey is from 20 h to 4 h; whenever this area is not accessible for at least 1.5 hours at an hour angle of less than 3.25 h, the time is given to SEGUE (e.g., the ends of the nights later in the Fall). Some smaller amount of time may be given to SEGUE in September and October so that SEGUE can obtain stripes and tiles at lower declination that can best be obtained in those months.
- 3) All other time is given to SEGUE. The choice between imaging and spectroscopy depends on atmospheric conditions (imaging if photometric, good seeing, and dark) and availability of sky. The imaging for a region of sky must proceed the spectroscopy, which is why there is no SEGUE imaging in 2008. In any month, the fraction of the astronomically useful time allocated for imaging never exceeds 23%, based on experience with SDSS-I.

As the Legacy footprint is filled in, the demands for time by Legacy as a function of month will change, and this development of the footprint is not predictable. The present unobserved area between stripes 10 and 37 can be seen at <http://www.sdss.org/status/imagingStatus.gif> and http://www.sdss.org/status/survey_area_covered_23.gif.

The model assumes something definite for filling in the Legacy footprint in order to create a definite baseline plan. In detail, the 2005 and 2006 profile for Legacy assumes a distribution of time by month based roughly on the distribution of Right Ascension for the remaining area. In 2007 and 2008, the 2005 and 2006 time for Legacy is reduced by a factor of 1.23. Thus the baseline plan calls for faster completion of Legacy in the North Galactic Cap than for the completion of SEGUE tiles in the same region of sky, but this balancing can be adjusted each year. The important part of the baseline is what each survey eventually yields by July 2008.

The model observing plan is a table of available hours per month, from 1 January 2005 to 30 June 2008, for each of the three surveys. To compute how many square degrees per hour are to be expected, we multiply the hours by 12.5 (as opposed to 18.75, which is the scan rate). The more conservative number corrects for inefficiencies and data that are collected but which do not pass the quality criteria. For Legacy, to compute the number of plates per hour, we adopt 1.8 hours per plate. Again, this is a conservative number based on SDSS-I experience that includes a correction for time spent obtaining plates in poor conditions with resulting longer exposures. As mentioned earlier, the number of SEGUE tiles is computed by assuming that each plate pair (SEGUE tile) requires 4.8 hours.

Legacy Survey Baseline

The baseline schedule for the Legacy survey is presented in Table 1 for imaging and for spectroscopy. Figures 1 and 2 present the same information in graphical form. As of 1 July 2005, approximately 200 square degrees remain to be completed for Legacy, and approximately 500 spectroscopic tiles.

Table 1. SDSS-II Baseline Projection – Legacy Survey

Period	Unique Imaging Area (sq. deg.)	Number of Spectroscopic Tiles
2005		
Q3	41	6.1
Q4	125	18.7
2006		
Q1		105.5
Q2		80.6
Q3		6.1
Q4		18.7
2007		
Q1		85.7
Q2		65.4
Q3		4.9
Q4		15.2
2008		
Q1		85.7
Q2		65.4
Total	166	558

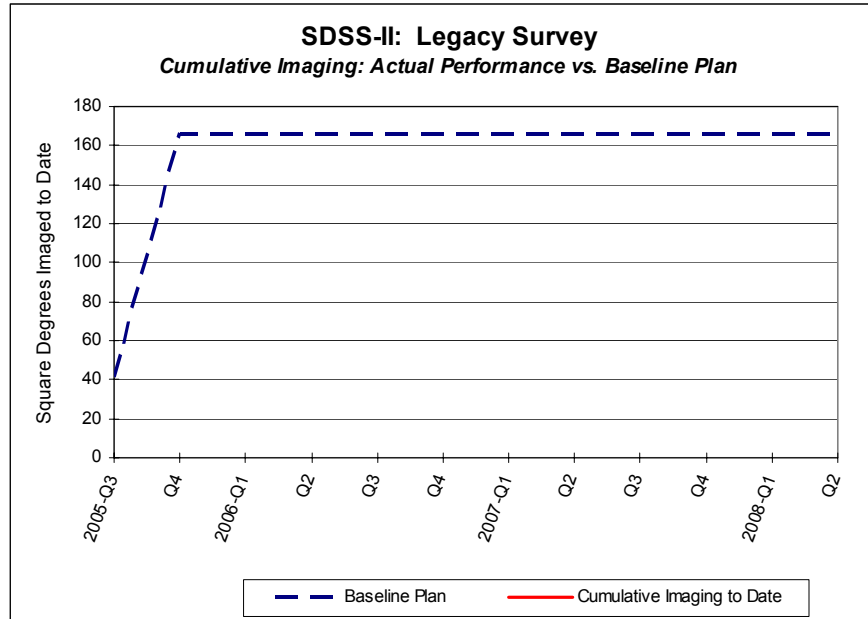


Figure 1. Baseline Imaging Schedule for the SDSS-II Legacy Survey

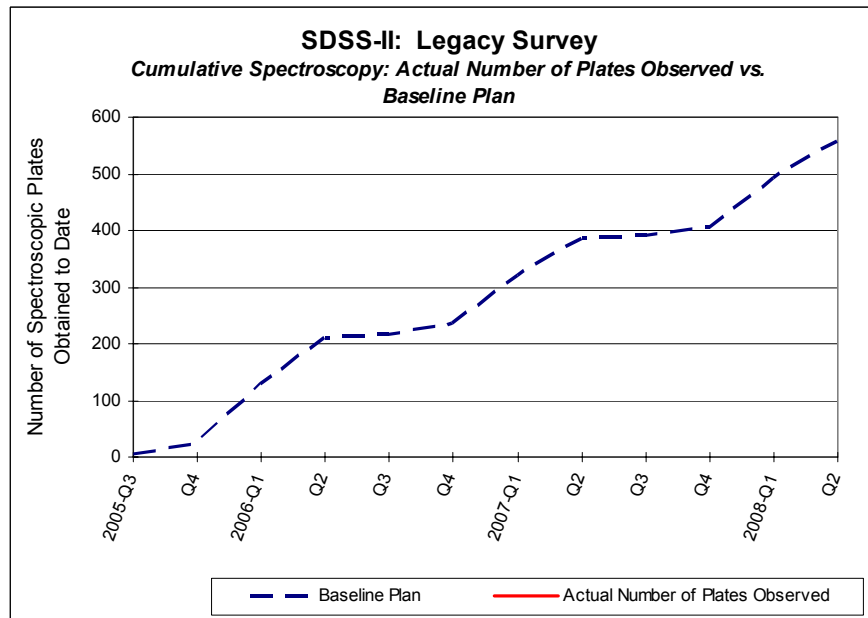


Figure 2. Baseline Spectroscopy Schedule for the SDSS-II Legacy Survey

SEGUE Survey Baseline

The baseline schedule for the SEGUE survey is presented in Table 2 for imaging and for spectroscopy. Figures 3 and 4 present the same information in graphical form. Although the SEGUE Survey goals are 3500 square degrees and 200 tiles, the projection in Table 2 shows a slightly smaller number for the imaging area. This is because the table covers the period from July 2005 through June 2008 and does not include SEGUE imaging data acquired prior this period.

Table 2. SDSS-II Baseline Projection – SEGUE Survey

Period	Unique Imaging Area (sq. deg.)	Number of Spectroscopic Tiles
2005		
Q3	201	11.2
Q4	306	17.1
2006		
Q1	460	15.2
Q2	225	12.5
Q3	210	11.8
Q4	430	17.1
2007		
Q1	535	21.4
Q2	303	16.9
Q3	215	12.1
Q4	435	18.3
2008		
Q1		30.3
Q2		21.9
Total	3320	205.8

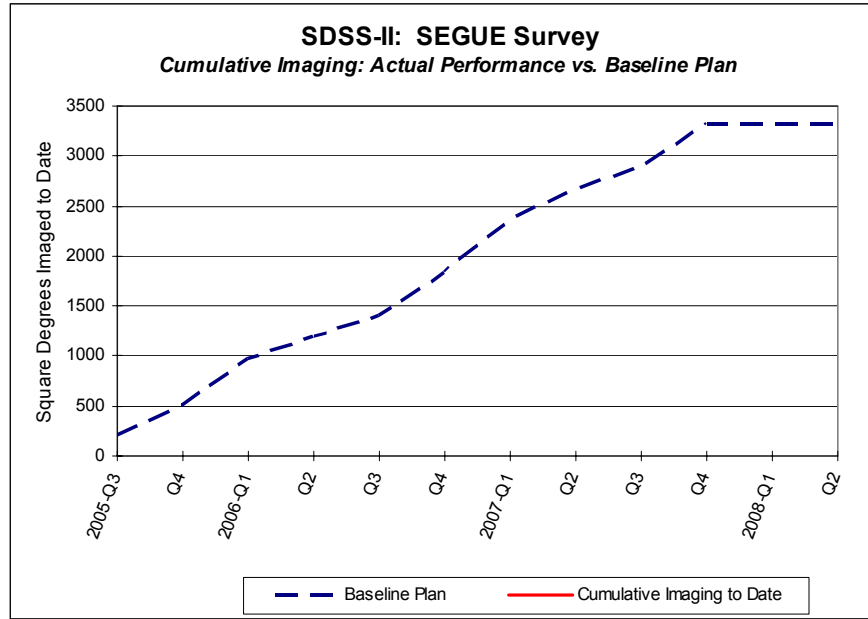


Figure 3. Baseline Imaging Schedule for the SDSS-II Legacy Survey

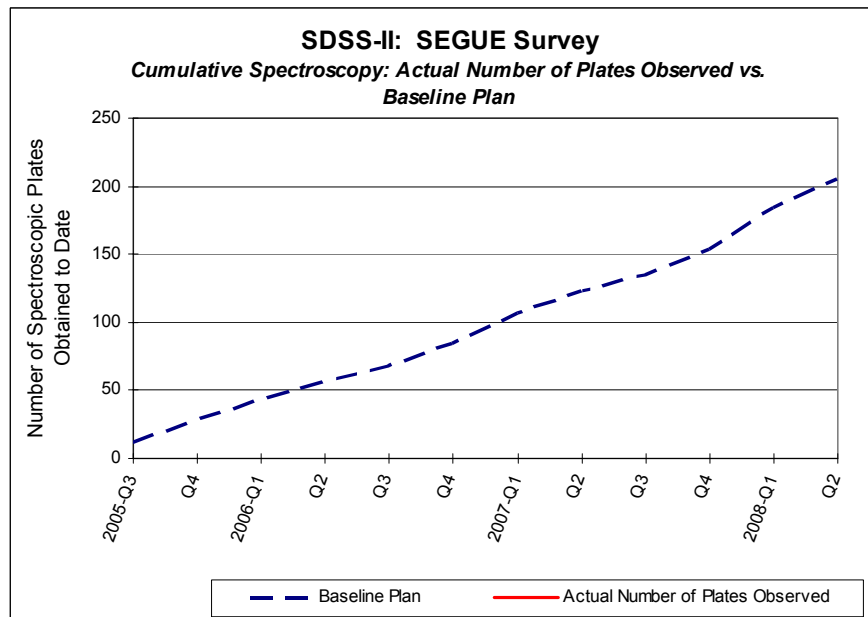


Figure 4. Baseline Spectroscopy Schedule for the SDSS-II Legacy Survey

SN Survey Baseline

For the SN survey, the model baseline observing plan allocates a certain number of hours useful for observing in the months September, October, and November, the same for 2005, 2006, and 2007 (ignoring details related to the lunations). The model assumes that time normally used for

spectroscopy is useful for SN imaging. For September, 10% of the available time is allocated for SEGUE, and this time is included in the Q3 baseline projection for SEGUE in Table 2. Similarly, for October 16% and for November 25% of the time is so allocated; this time for SEGUE is included in the Q4 baseline projection for SEGUE in Table 2.

The specific time for SEGUE in September and October in practice will be scheduled by the Head of Survey Coordination, taking into account the needs of both SEGUE and SN. The values of 10% and 15% for September and October, respectively, are not goals, but are rather estimates of the average amounts of time needed by SEGUE in those months. For November, the value of 25% reflects both the time not useable by SN because of airmass constraints, plus a lowered need for dense sampling at the end of the season.

After these allocations of time for SEGUE in the months of September, October, and November, the baseline model provides for 80 hours for SN in September, 83 hours in October, and 79 hours in November. These times are already corrected for inefficiencies, and so can be converted to square degrees by multiply by 18.75 square degrees per hour. In addition to this time, SN will observe during bright time, which will increase the hours quoted above by a factor of 1.25. In total, the model provides, on average, complete coverage of the 300 square degree area 19 times per season. In practice, some parts of the footprint will be covered more often and some less often, of course.